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Critical thinking skills of high school students material invertebrates trought guided inquiry assitend mind mapping

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ABSTRACT

The inquiry learning model can help students learn independently in solving problems and providing solutions. The study aims to identify improvements in students' critical thinking skills on invertebrate material through guided inquiry-assisted mind mapping. The type of research used is pre-experimental research with a one-group pretest-postest design. The population in this study was an entire MIA X class, consisting of 16 samples. The test instrument is used as a double-selection test (PG) with 20 reasonable questions about invertebrate material. Sampling is done using probability sampling with saturated sampling. Guided inquiry learning activities assisted by mind mapping are carried out in six stages. 1) presenting questions or problems; 2) making hypotheses; 3) designing experiments; 4) conducting experiments to obtain information; 5) collecting and analyzing data; 6) drawing conclusions. The results of this study show that any critical thinking skill indicator, i.e., focusing questions, analyzing arguments, asking or answering a question, investigating and/or considering observation reports, considering credible sources, taking into account valuable opinions, making and/or considering inductions, identifying assumptions, identifying terms and/or considering definitions, and determining an action, produces a significance of 0.000 < of 0.05, which means there is an influence of the learning model on critical thinking skills.

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INTRODUCTION

Learning in the 21st century that needs to be applied by students is the ability to think higher-order, one of which is thinking skills (Anggraeni et al., 2016). Critical thinking skills are

skills that focus students on making decisions, analyzing, and evaluating a problem that can be solved (Solihin, 2018). Everyone needs critical thinking skills to practice responsibility and be able to solve the problem at hand. (Susilowati et al., 2020) He said that critical thinking skills and creative thinking skills are part of the 21st century. Critical thinking skills can be taught and developed through biology learning. In biology learning, students are taught to acquire knowledge, collect data, and communicate to produce reliable explanations.

Critical thinking skills are essential for a person to make decisions and solve problems. To be a critical person, you must be confident in your abilities. So if someone has high self-confidence, then the student will have confidence and courage to do or do something. Hakim (2018) said that higher-order thinking must be possessed by a student is a critical thinking process, because critical thinking, can train students to analyze problems and solve problems in anything. Thus, critical thinking skills are essential to be provided to students, to survive and be able to compete globally in this industrial era. Based on the observations that have been made show that the critical thinking skills of students are not maximum, this is demonstrated by the student's inability to provide solutions related to the processing of natural resources in particular in invertebrates sustainably. Besides, in general, the KKM's value is still unclear. The student's inability to provide a solution because learning is still monotonous and boring, the lack of a learning model that is applied to biological subjects, especially invertebrate matter, is the cause of a lack of critical thinking skills students, so it needs a model of learning, which can provide the students with the skills to think critically. Students' critical thinking skills in education can be pursued through a learning process that involves students being able to solve the problems faced, therefore the stages of guided inquiry learning can make student activities that lead to students' critical thinking skills (Nurmayani, 2018). Guided inquiry learning is an aid in biology learning to be able to grow students' critical thinking skills at school (Azizah, 2016).

Learning through guided inquiry is learning that encourages students to bring out their abilities. Guided inquiry is learning that involves all students' abilities to find and find answers to existing problems (Trianto, 2010). This is in line with the opinion of Rambe et al., (2020) That said, through guided inquiry learning is learning that encourages students to think deeply, seek and explore, and actively participate in learning activities. Through these activities, students can learn to present questions or problems, make hypotheses, design experiments, conduct experiments to obtain information, collect data and analyze data, and make conclusions. Guided Inkuri has the advantage of being able to train students in developing critical thinking skills, and building self-confidence, in the process of inquiry because learning is student-centered (Sanjaya, 2005).

In addition to advantages, the inquiry also has disadvantages. In the guided inquiry stage, there are no stages that will provide a thinking experience at the beginning of learning, so student readiness during the learning process is less than optimal (Abhimanyu, 2013). Therefore, there is a need for tools to overcome these weaknesses, namely using mind mapping. Mind mapping is a learning method designed to develop students' creativity, facilitate students' memory, and arrange ideas from a concept into a mind map that is easily understood by students (Darusman, 2014). Using media tools such as mind mapping will train students to solve existing problems, in real and students will imagine which will later be poured into Mind Mapping. This guided inquiry learning model assisted by mind mapping will be able to make students responsible, think critically, find a concept based on experience, and find information and data needed. In addition to learning models, students' critical thinking skills in understanding the material are also very necessary, because in that material more reasoning is needed (Ministry of Education and Culture, 2016). Especially for materials related to invertebrates in class X MIA.

Invertebrates are one of the materials in biology subjects that require students to think in higher order, one of which is critical thinking. This material is interesting because there are several

phyla of invertebrates that have benefits for animals, humans, and plants such as phylum Porifera can produce bioactive compounds and form diversity on the seabed. Then the arthropod phylum can help pollinate plants and many more phyla can provide benefits. Therefore, critical thinking skills are needed by students, to have the ability to solve a problem and it will be easier to find new ideas in a material.

Previous research has applied many guided inquiry learning models combined with mind mapping to see the influence on students' critical thinking skills, it is proven that the influence of guided inquiry learning models combined with mind mapping causes the value of students' biological critical thinking skills to be higher (Susanti M, 2019). Meanwhile, other research improves critical thinking skills through the subject matter of plant tissue structure and function (Noralifah, 2019). Linking concepts to facts means that students have thought logically and analytically it will trigger students to think more critically (Ade Nursyamsi, 2021). Indicators of critical thinking skills that are the focus of research are adopted from Ennis (1985), focused on ten indicators, namely: 1) Focusing questions 2) Analyzing arguments 3) Asking / or answering questions 4) Investigating and/or considering observation reports 5) Considering the credibility of sources 6) Considering opinions that are valuable 7) Making and/or considering inductions 8) Identifying assumptions 9) Identifying terms and/or Consider the definition 10) Define an action. Many studies have applied the guided inquiry learning model to critical thinking skills. However, it is rare to find guided inquiry learning assisted by mind mapping students' critical thinking skills on invertebrate material, with many indicators adopted from Ennis (1985).

Some things that must be considered before guided inquiry learning assisted mind mapping of high school students critical thinking skills on Invertebrate material is to prepare learning tools consisting of lesson plans, student worksheets, and test instruments. Based on the description above, the purpose of this study was to determine the influence of students' critical thinking skills on invertebrate material through guided inquiry assisted by mind mapping.

RESEARCH METHODS

Research Design

This research is a quantitative study using pre-experimental methods and using a group pretest-postest design. In this design a pretest is done to know the initial state, then a treatment is given using a guided inquiry learning model assisted by mind mapping after being given a treatment assigned to the posttest to see the outcome or changes.

Table 1. Pretest-Postest Design

Pre-test	Treatment	Post-test
O_1	X	O_2

Note:

O_1 : Pre-testing

O_2 : Post-testing

X : Treatment

Population and Samples

The population of this study was 16 MIA X class students, 4 males, and 12 females, and the sample in this study were 16. The sampling technique using nonprobability samplings with saturated samplers is a technique that determines samples using all members of the population as samples.

Instruments

Techniques and data collection instruments used in this study consist of critical thinking skills data of students of 20 items. Instruments in the form of double selection (PG) are learning

achievement scores obtained through pretest and posttest given in the format of double choice questions (PGs) 20 items of questions. Instrument critical thinking skills use Ennis (1985), framework with 10 indicators, namely: focus questions, analyze arguments, ask/or answer questions, investigate and/or consider observation reports, consider credible sources, consider valuable opinions, make and/ or consider inductions, identify assumptions, identify terms and/or consider definitions, and determine an action. The data was obtained from the pretest and the post-test. The instruments used in the research were first validated by two validators.

Procedures

The steps of guided inquiry learning assisted by mind mapping in Invertebrate material There are six cycles of guided inquiry learning: presenting questions or problems about invertebrate material, making hypotheses (temporary answers), designing experiments (using the help of mind mapping), conducting experiments to obtain information (answering questions), collecting data and analyzing data (students presenting the results of discussions in front of the class) and make conclusions (determine actions in deciding by relevant data and sources).

In the invertebrate material, there are ten CTS indicators developed, in detail can be seen in Table 1 on the development of test instruments from each indicator of Critical Thinking Skills (CTS).

Table 2. Development of Critical Thinking Skills (CTS) Indicators on Invertebrate Material

Indicators CTS	Developed Test Items
Ask/or answer questions	Identify the characteristic characteristics of invertebrate animals
Identify terms and/or consider definitions	Identifying the features of the phylum Porifera
Investigate and/or consider observation reports	Classifying phylum cnidarians based on traits
focusing questions	Classifying phylum echinoderms based on their characteristics
Analyze arguments	Analyzing the phylum platyhelmintes
Define an action	Identifying the features of the phylum mollusca
Consider the credibility of the source	Grouping phylum annelids based on their characteristics
Identify assumptions	Analyze the phylum nemathelmintes based on their features
Create and/or consider inductions	Analyze the differences between phylum platyhelmintes and nemathelmintes based on their characteristics
Consider valuable opinions	Classifying arthropod phyla based on their characteristics

Data Analysis

The data analysis is carried out by calculating the values of the pre-test and post-test results, then continued with the normality statistical test (Shapiro Wilk), after which the hypothetical test (Wilcoxon Test) was carried out using IMB SPSS 26.

RESULTS

Critical Thinking Skills

The data showed that students' critical thinking skills affect the guided inquiry learning model assisted by mind mapping, in every learning process that takes place. Students' critical thinking skills from pretest and posttest score data for each indicator obtained by students can be seen in Figure 1.

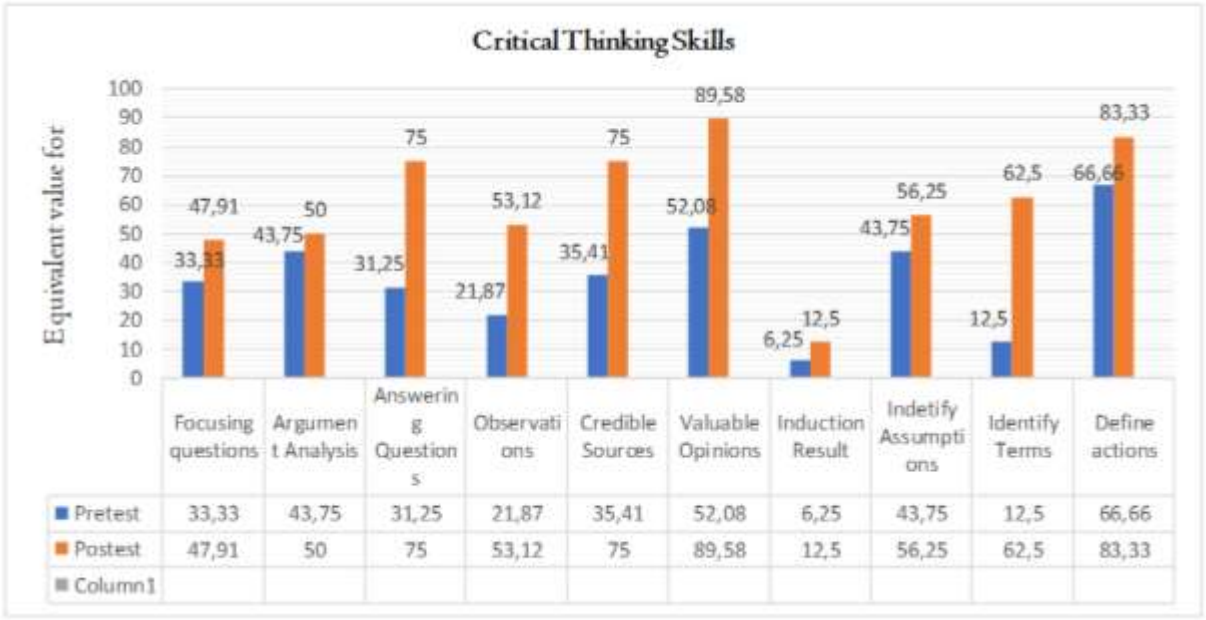

Figure 1. Average Pretest and Postest Score Data on Each Critical Thinking Skills Indi

Based on Figure 1. shows that there is an increase in the value of pretest and postest learning outcomes from the ten indicators of critical thinking skills. Data on critical thinking skills outcomes were measured using a multiple-choice test consisting of 20 questions. In Table 1. It can be seen that there is a descriptive statistical analysis of Pretest and post-test in each indicator.

Table 3. Pretest and Postest Descriptive Statistical Analysis in each KBK Indicator

Indicators	Average Pre and Post	Normality Test	Homogeneity Test	Wilcoxon Test	Information
Focusing Questions	33.33	0.003	-	0.000	Differs
	47.91	0.013	0.000		significance
Argument Analysis	43.75	0.000	-	0.000	Differs
	50	0.000	0.000		significance
Answering Questions	31.25	0.001	-	0.000	Differs
	75	0.000	0.000		significance
Observations	21.87	0.000	-	0.000	Differs
	53.12	0.005	0.000		significance
Credible Sources	35.41	0.005	-	0.000	Different
	75	0.001	0.000		significance
Valuable Opinions	52.08	0.002	-	0.000	Differs
	89.58	0.000	0.000		significance
Induction Results	6.25	0.000	-	0.000	Differs
	12.5	0.000	0.000		significance
Identify Assumptions	43.75	0.000	-	0.000	Differs
	56.25	0.000	0.000		significance
Identify Terms	12.5	0.000	-	0.000	Differs
	62.5	0.000	0.000		significance
Define actions	66.66	0.005	-	0.000	Different
	83.33	0.000	0.000		significance

Based on table 3. The results of the statistical analysis using Wilcoxon, for the normality test obtained a significance value <0,05, so it can be stated that the data before and after the treatment are not distributed normally. Furthermore, the average difference test (Wilcoxon) obtains a signification level of 0.00 less than 0.05 (p<0,05) meaning there is a difference in the critical thinking skills of students before and following the application of the mentored mind mapping learning model, where the student's critical thought skills are better when applying the guided inquiry in the learning process.

DISCUSSION

Based on Figure 1. The indicator of focusing questions has been done with a poor post-test value. This is because students' initial knowledge is very weak regarding the material for classifying phylum echinoderms based on their characteristics. Students are required to identify the characteristic characteristics of invertebrate animals by paying attention to the stages in the form of analyzing and discussing to find out the echinoderm phylum group. Students can already formulate a problem but have not maximally implemented it. This is in line with research conducted by (Fernanda et al., 2019) While the question-focused indicator can identify questions/problems easily, students can quickly study a case and understand it.

On the indicator analyzing arguments is already done with a fairly good posttest value. This means that students can analyze a reason that proves the truth or invalidity of a statement in the phylum platyelmintes material, students are required to be able to express a reason with strong evidence. In the guided inquiry learning model, indicators of analyzing arguments are found at the stage of making hypotheses where students collaborate with discussions to obtain information with real evidence. This is in line with the pugale quoted by Rahmawati (2013) that students need to be accustomed to providing arguments for answers given in learning, as well as providing responses to answers given by other students.

The indicator of asking / or answering questions has been done with the maximum posttest value. The ability to ask questions and answer questions is the ability to find existing facts, from a problem that is used to answer the problem. This means that students can find facts that exist in a problem well regarding the material characteristics of invertebrate animals. In the inquiry learning model, indicators of asking/or answering questions, are found at the stage of making hypotheses, where students are asked to be able to find facts about the phylum echinoderms. This is reinforced by the results of research conducted by (Fernanda et al., 2019) on the indicators of asking/or answering questions, obtained results, that students still had difficulty in finding the facts of the problem, but managed to identify several species.

In the indicators, observations have been made with a posttest value of less than optimal. Considering observation reports is an ability of Students in providing real evidence based on observations from data. This means that students' ability to find relevant references related to phylum coelenterata is very limited, so students do not know specifically, knowledge about phylum coelenterata is also still weak, this knowledge weakness is because students have never had activities / physical contact with phylum coelenterata. These findings reinforce previous findings collected using critical thinking skills test instruments and assignments in the form of papers without emphasis on concepts so that no information is obtained as a whole (Wahyudi, 2020). This is also in line with research (Jumrodah et.al., 2019; 2021) That students' critical thinking skills are still low, this is because assignments only use presentation and discussion methods without any emphasis on clear and easy-to-understand concepts.

On the indicator consider credible sources already done with a high posttest value. Considering the credibility of sources is a person's ability to use existing ways of working, in solving the problem at hand. This means that students can give different ideas for solving a

problem in uncertain conditions. This is reinforced by the opinions of Shim and Walczak (2012) and Kong (2015) that students should synthesize and evaluate information to decide what actions to take during reasoning and problem-solving. In the inquiry learning model, indicators consider credible sources at the stage of collecting data and analyzing data, where students are asked to find and consider real data about phylum annelids.

In the indicator considering valuable opinions has been done with a high post-test value. This means that students have carried out the teaching and learning process by obtaining valuable results regarding arthropod phylum material, with useful circumstances, and by the guided inquiry learning model. In the inquiry learning model, indicators consider valuable opinions, found at the stage of designing experiments, students are required to analyze appropriate arguments, to obtain important information from arthropod phyla. This is in line with research conducted by (Changwong et.al., 2018) that almost all students can consider various references, as well as arguments explained by others.

The indicator of making and/or considering induction has been done with a very low post-test value, this is because students' initial knowledge is very weak about the differences in phylum platyhelmintes and nemathelmintes based on their characteristics. This means that students are asked to be able to improve their logic so that they can understand concepts well because considering the results of induction is related to making conclusions and making hypotheses. This is reinforced by research conducted by Hariyani et.al., (2017) that students are asked to be able to identify problems to provide opportunities, analyze data and strengthen their opinions. This indicator is found in the guided inquiry stage, which is conducting experiments to obtain information, where students are asked to consider logical and valid conclusions. This is in line with the research conducted (Jumrodah et al., 2021) the ability to conclude the concepts learned and events experienced during practicum activities is expected to improve logic so that they can understand the concepts well.

In the indicator identifying assumptions has been done with a fairly good posttest value. Identifying assumptions is the ability to reason and reconstruct valid arguments. This means that some students have not shown adequate reasoning skills. Students who have not been able to conclude the concepts taught and events experienced during discussion activities are expected can improve their reasoning skills so that they can understand concepts well about the material of phylum nemathelmintes based on their characteristics. This is in line with research conducted by (Fitriyah et al., 2021) That the learning process can provide conclusions and reflection activities can provide improvements in subsequent activities, at the evaluation stage requires students to be able to think critically in assessing the positive side and the negative side.

On the indicator identifying the term is already done with a fairly good posttest value. This means that students can already grow and practice their thinking skills by providing clear and detailed explanations of the material of the phylum Porifera. In the guided inquiry learning model, this indicator is at the stage of collecting data, and analyzing data means students dare, and analyzing data means students dare to express their opinions about the material. It is consistent with research carried out by (Sofri et.al., 2020) that the skill of defending and considering the results of definitions by applying PBL is a good category because the PBL model students understand abstract concepts.

The indicator determines an action already done with a high post-test value. This means the student has been able to follow and analyze the methods given by the teacher well about the material of the molluscan filum. Students are asked to be able to design and design learning methods by paying attention to the stages of the inquiry learning model guided to determine the outcome of the appropriate problem-solving. It is in line with research carried out by Ghanizadeh

et al. (2020); Wahyudi (2020) and Ida et al (2013) that critical thinking skills develop through mature effort and planning.

CONCLUSION

The results of this study conclude that guided inquiry learning helps mind mapping influence the critical thinking skills of high school students on invertebrate material. The improvement in critical thinking skills is demonstrated by the difference in the value of the pre-test and post-test results from the overall critical-thinking skills indicators, as well as evidence from analytical calculations using the wilcoxon test that yields a significance of asymmetric sig = 0,000. It is expected that future IPA learning can use models or approaches creatively and innovatively, thus providing critical thinking skills. Critical thinking skills are important skills and should be provided to students in this 21st century. It is recommended for future researchers to use the instruments of each critical thinking skill indicator, in order to generalize their students' ability to think critically. In addition, it does not close the possibility of developing a learning medium or a suitable learning tool for the application of a guided inquiry learning model in the future.

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